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INDEX TO WATERVLIET ARSENAL TECHNICAL REPORTS, 1973

E. Losee, et al

Watervliet Arsenal

Prepared for:

Army Armament Command

September 1973

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AD

INDEX TO WATERVLIET ARSENAL TECHNICAL REPORTS, 1973

E. LOSEE

A. BEHN

BENET WEAPONS LABORATORY
WATERVLIET ARSENAL
WATERVLIET, N.Y. 12189

SEPTEMBER 1973

TECHNICAL REPORT

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Watervliet Arsenal
Watervliet, N.Y. 12189

2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
THE CORRELATION BETWEEN FIRING AND LABORATORY CYCLING FROM STATISTICAL ANALYSIS OF GUN BARREL FATIGUE DATA

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Technical Report

5. AUTHOR(S) *(First name, middle initial, last name)*
R. L. Racicot R. R. Fujczak
J. F. Throop T. E. Davidson

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U.S. Army Weapons Command

13. ABSTRACT

Fatigue test results from cannon tubes fired to failure, tubes alternately fired and laboratory cycled to failure, tubes fired and subsequently laboratory cycled to failure and tubes laboratory cycled only to failure are analyzed.

Point estimates and confidence intervals on the correlation factor k in the expression

$$X = \text{Rounds} + k(\text{cycles})$$

are determined, assuming a lognormal distribution law for the random variable X, the fatigue life expressed in fired rounds, and using Bayesian methods for obtaining confidence limits.

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1. ORIGINATING ACTIVITY (Corporate author)

Watervliet Arsenal
Watervliet, N.Y. 12189

2a. REPORT SECURITY CLASSIFICATION

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2b. GROUP

3. REPORT TITLE

EFFECT OF CARBONACEOUS GAS ENVIRONMENT ON THE CORROSION OF AISI-4330 HIGH STRENGTH STEEL

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Technical Report

5. AUTHOR(S) (First name, middle initial, last name)

Fumihiko Saegusa

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
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10. DISTRIBUTION STATEMENT

Approved for public release; Distribution unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U. S. Army Weapons Command

13. ABSTRACT

Corrosion of high strength steel in gaseous environment is largely divided in two areas, high temperature oxidation and stress corrosion cracking at lower t[illegible] ma-tures. High temperature oxidation of the 4330 steel was conducted in CO-CO_2 mi[illegible]res up to 1500°C. The reaction includes decarburization, internal and external oxidation depending on the composition of the gas mixture and temperature. Cracks were observed after the stage of internal oxidation. Stress corrosion test revealed that the 4330 is susceptible to stress corrosion cracking in CO-CO_2 in the presence of moisture. The cracking is transgranular and appears to involve hydrogen embrittlement at the crack tip.

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Watervliet Arsenal
Watervliet, N.Y. 12189

2a. REPORT SECURITY CLASSIFICATION

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3. REPORT TITLE

HI-RATE LOADING OF BARRELS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Technical Report

5. AUTHOR(S) (First name, middle initial, last name)

J. D. Vasilakis

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10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY AC
	U.S. Army Weapons Command

13. ABSTRACT

An experimental test facility has been developed to simulate to a certain degree in a laboratory the loading and thermal environment experienced by gun barrels in automatic weapons. The test facility is capable of pressurizing hollow thick-wall cylinders cyclically at a rate of 550-600 cycles per minute and at pressures of 3500 kg/cm². The rise time of the pressure pulse is less than 1 millisecond (strain rates of about 3/second) and test temperatures are 260°C, 538°C and 815°C. Temperature is held constant during the test.

An automatic air driven hammer is used as the energy source to provide the cyclic loads and a solid loading medium is used to transmit pressures in the specimen. This report discusses the background of the program, the development of the apparatus and the results to date.

The facility was initially designed and built to test potential gun barrel materials and configurations. Currently being tested are specimens fabricated from CG27, Udimet 700, and conventional Cr-Mo-V steel.

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3. REPORT TITLE

"EFFECTIVE STIFFNESS" MODES FOR LAMINATED COMPOSITE MATERIALS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Technical Report

5. AUTHOR(S) (First name, middle initial, last name)

C. E. Thomas

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprint from Journal of Sound & Vibration (1973)23(3)341-361	U.S. Army Weapons Command

13. ABSTRACT

The simple thickness modes for laminated media with layering both parallel and perpendicular to the plate free surfaces are studied according to the "effective stiffness" theory and the results obtained are compared to results found from the "effective modulus" theory. The importance and effects of the number of layer pairs for layering parallel to free surfaces and of the ratio of plate thickness to the thickness of a layer pair for layering perpendicular to free surfaces on dimensionless "effective stiffness" frequencies are considered. The various "effective stiffness" and "effective modulus" frequency equations have been solved for a stiff matrix-stiff reinforcing layer material and for a soft matrix-stiff reinforcing layer material; the results are presented in graphs depicting the variation of dimensionless frequency with changes in dimensionless thickness ratio. For a small number of layers parallel to the free surfaces and for small values of thickness ratio, γ, for laying perpendicular to the free surfaces, the microstructure effects included in the "effective stiffness" theory become dominant and the resulting modes differ considerably from the corresponding "effective modulus" theory modes. However, for a large number of layers parallel to the free surfaces and for large values of thickness ratio, γ, for layering perpendicular to the free surfaces, the "effective modulus" theory gives results in excellent agreement with the "effective stiffness" theory.

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3. REPORT TITLE

ARTILLERY PRIMER FOR SEPARATE LOADED CANNON

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Technical Report

5. AUTHOR(S) *(First name, middle initial, last name)*

Herman J. Reepmeyer

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U.S. Army Weapons Command

13. ABSTRACT

A series of tests were conducted to determine the most feasible configuration for an artillery primer that would be suitable for both hand and automatic feeding. Various fillers were also tested to obtain an optimum ignition train. Because of their interrelation, various firing mechanism characteristics were considered, with a more compatible cannon initiator (firing unit) - propellant ignition train interface being achieved.

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3 REPORT TITLE

A MODIFIED COLLOCATION METHOD FOR C-SHAPED SPECIMENS

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)

Technical Report

5 AUTHOR(S) (First name, middle initial, last name)

M. A. Hussain S. L. Pu
W. E. Lorensen
D. P. Kendall

6 REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO OF REFS
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10 DISTRIBUTION STATEMENT

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11 SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U.S. Army Weapons Command

13 ABSTRACT

The stress intensity factor for a thick-walled cylindrical section with a straight, radial crack has been obtained by a modified boundary collocation method. The results obtained by this method are in good agreement with previously obtained experimental results. The application of this method to other component configurations can give an accurate K-calibration.

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Watervliet Arsenal
Watervliet, N.Y. 12189

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
MINIMUM EFFECTIVE COST DESIGN OF COMPOSITE CYLINDRICAL PRESSURE VESSELS RELATED TO GUN TUBES

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Technical Report

5. AUTHOR(S) *(First name, middle initial, last name)*
Lawrence V. Meisel

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U. S. Army Weapons Command

13. ABSTRACT

The dimensions of a composite gun tube consisting of a cylindrical liner and a cylindrical jacket of dissimilar materials necessary to endure given internal pressures are determined theoretically.

The dimensions are optimized with respect to effective cost which is defined in terms of both material cost and cost per pound of weight to the external system (penalty factor) within constraints imposed on the stress levels reached in liner and jacket through a yielding criterion.

Results are presented for a steel liner - glass epoxy jacket composite tube for a variety of costs per pound to the external system. Comparisons are made with respect to minimum weight design and conventional tube designs.

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Watervliet, N.Y. 12189

2a. REPORT SECURITY CLASSIFICATION

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3. REPORT TITLE

A COUPLE-STRESS THEORY FOR LAMINATED MEDIA

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Technical Report

5. AUTHOR(S) (First name, middle initial, last name)

Charles R. Thomas

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U. S. Army Weapons Command

13. ABSTRACT

A derivation of a couple-stress theory for a laminated medium is developed in detail. Simple thickness modes are used to show the relationship of the theory to a corresponding effective modulus theory. Simple wave propagation problems are used to show when the new theory is dispersive in nature.

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1. ORIGINATING ACTIVITY *(Corporate author)*

Watervliet Arsenal
Watervliet, N.Y. 12189

2a. REPORT SECURITY CLASSIFICATION

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3. REPORT TITLE

A TECHNIQUE FOR WEIGHING A SINGLE WHISKER

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Technical Report

5. AUTHOR(S) *(First name, middle initial, last name)*

R. A. Warenchak,
K. E. Loomis, and
I. Ahmad

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from Chemical Instrumentation, 4(2), pp. 115-120 (1972)	U. S. Army Weapons Command

13. ABSTRACT

A simple technique to determine the mass and density of extremely small-sized specimens.

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7. AUTHOR(s) Y.K. Huang		8. CONTRACT OR GRANT NUMBER(s) AM CMS No.5I3.I2.050I4.02 DA Project No. IFI63206D050
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Nonsteady Nozzle Flow
Shock Waves
High Pressure
Similarity and Scaling
Gun Firing
Transition Ballistics
Nozzle Blast

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This is a summary report of the investigation performed for a recent task concerning recoilless rifle nozzle blast. On the basis of plane and spherical blast waves, scaling formulas are derived for evaluating the distribution of peak pressures along the gun axis and at some slant distances. Basic input data are those as given by the breech pressure, nozzle expansion ratio, and firing duration. Calculations of this investigation are straightforward and self consistent.

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Watervliet, N.Y. 12189

2a. REPORT SECURITY CLASSIFICATION

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2b. GROUP

3. REPORT TITLE

AN ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF THE STRESS FIELD IN AN ANNULAR FINNED HOLLOW TUBE

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Technical Report

5. AUTHOR(S) (First name, middle initial, last name)

G. A. Pflegl
G. C. Carofano

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U.S. Army Weapons Command

13. ABSTRACT

The stress field in a hollow tube with annular fins integrally machined on its outer surface was determined by the finite-element technique (NASTRAN) and an approximate one-dimensional model. Some previously unreported experimental photoelastic results are also presented and good agreement is shown between all three methods. Two FORTRAN program listings are included.

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1. ORIGINATING ACTIVITY (Corporate author)

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2a. REPORT SECURITY CLASSIFICATION

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3. REPORT TITLE

INFANTRY SUPPORT WEAPONS SYSTEM TECHNOLOGY (PROJECT DES-VAL)
A REVIEW OF MATHEMATICAL MODELS RELEVANT TO AUTOMATIC WEAPONS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Technical Report

5. AUTHOR(S) (First name, middle initial, last name)

Thomas F. Simkins, John D. Vasilakis, Garry C. Carofano, Maurice A. Scavullo and Ronald L. Racicot

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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10. DISTRIBUTION STATEMENT

Approved for public release; distribution unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U. S. Army Weapons Command

13. ABSTRACT

The principal effort of the math-modeling portion of Project DES-VAL (Design Evaluation of 20-40mm Gun Systems) was in establishing an up-to-date knowledge of existing computer models of automatic weapons. Included in this report is a listing of approximately four hundred documents surveyed for relevance in five separate categories, i. e. Dynamics, Vibration, Stress, Heat Transfer, Reliability, and Math-Modeling. A brief account is given of the general course of math-modeling including recommendations for future work.

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2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
DYNAMIC STRESS INTENSITY FACTOR FOR AN UNBOUNDED PLATE HAVING COLLINEAR CRACKS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
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5. AUTHOR(S) (First name, middle initial, last name)
M. A. Hussain
S. L. Pu

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Reprinted from Engineering Fracture Mechanics, 1972, Vol. 4, pp. 865-876	U.S. Army Weapons Command

13. ABSTRACT

The steady-state vibration of an infinite plate with collinear cracks is considered for low frequency cyclic loading. The formulation of the mixed boundary value problem leads to a dual trigonometric series. The Schwinger's method gives an automatic perturbation scheme. The dynamic stress intensity factor is found to be higher than the corresponding static one. The inertial effect on the stress intensity factor becomes significant only when the frequency of the external load is close to that of the shear wave.

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ON THE STABILITY OF A DEEP BEAM SUBJECTED TO NONCONSERVATIVE AND DISSIPATIVE FORCES

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Technical Report

5. AUTHOR(S) *(First name, middle initial, last name)*
Gary L. Anderson

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10. DISTRIBUTION STATEMENT
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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U.S. Army Weapons Command

13. ABSTRACT

The mode of loss of stability of a hinged-hinged beam subjected to a concentrated, transverse follower force applied at the center of the beam is considered. Due to the nature of the nonconservative applied load, the flexural and torsional deformations of the beam are coupled. The effects of warping rigidity and internal and external damping have been included in the differential equations of motion. The stability problem is solved in an approximate manner by means of an adjoint variational principle. Several graphs are presented to demonstrate the effect of the various damping and rigidity parameters on the value of the flutter load. These results reveal that in the absence of external damping, the value of the flutter load becomes arbitrarily small as the internal damping parameter associated with flexure tends to zero.

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3. REPORT TITLE
K CALIBRATION FOR "C" SHAPED FRACTURE TOUGHNESS SPECIMENS OF VARIOUS GEOMETRIES

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Technical Report

5. AUTHOR(S) *(First name, middle initial, last name)*
J. H. Underwood
R. D. Scanlon
D. P. Kendall

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U.S. Army Weapons Command

13. ABSTRACT

Prior collocation results are combined with new collocation data and analyzed using two parameter data approximation methods and fracture mechanics methods. A general K calibration is obtained for "C" shaped specimens which have outer to inner radius ratios, $W = r_2/r_1$, between 1.4 and 3.5.

The K calibration for "C" shaped specimens is found to depend on the load eccentricity to specimen thickness ratio, x/t, as well as the usual crack depth to specimen thickness ratio, a/t. The K results are presented as tabular and plotted values from a cubic spline surface used to approximate the collocation data and as a polynomial approximation of the collocation data over a more limited range of x/t.

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3. REPORT TITLE

A PHENOMENOLOGICAL DESCRIPTION OF CENTRAL BURST FORMATION DURING HYDROSTATIC EXTRUSION

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Technical Report

5. AUTHOR(S) (First name, middle initial, last name)
Joseph Pepe

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11. SUPPLEMENTARY NOTES

12. SPONSORING MILITARY ACTIVITY
U. S. Army Weapons Command

13. ABSTRACT

A detailed metallographic investigation of the phenomenological development of central burst defects during hydrostatic extrusion was conducted. The characteristic extrusion pressure versus billet-displacement curve of extrusions containing center burst defects was periodic; each periodic segment consisted of a constant pressure part during which the extrusion velocity was slow followed by a decreasing pressure part during which the extrusion velocity was rapid. It was established that during the part of the cycle exhibiting slow billet movement, near the billet centerline beyond the end of the die deformation zone, small microcracks formed, linked-up by tensile fracture and formed a rather large cone shaped defect exhibiting little crack opening displacement. During the portion of the periodic cycle exhibiting rapid billet movement, the cone shaped defect developed into a typical central burst defect by shear fracture at the crack tips. It was established that the volume of material immediately behind the rather large cone shaped defect, present in the deforming billet at the end of the slow velocity part of the periodic cycle, behaves as a rigid body thereby forcing the material in the die deformation zone near the die surface to squirt by this rigid body as it moves through the die orifice. The entire central burst defect after the rapid forward billet movement lies beyond the end of the die deformation zone and thus, with further extrusion, the entire cycle can repeat. The squirting action of material past the rigid body was responsible for both the shear fracture near the crack tips and the large crack opening displacement of the central burst defect.

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3. REPORT TITLE

FINITE ELEMENT ANALYSIS OF A MUZZLE BRAKE

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Technical Report

5. AUTHOR(S) *(First name, middle initial, last name)*

F. J. John

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U.S. Army Weapons Command

13. ABSTRACT

This report describes the stress analysis of a muzzle brake by the finite element method, NASTRAN. The model is described with its constraints and pressure loads, and results given for two different conditions. Results of one analysis are compared with a measured stress to identify the magnitude of pressure loading. Final results include maximum principal and maximum shear stresses with directions of principal stresses.

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3. REPORT TITLE
WHITE LAYER DISTRIBUTION IN A 105MM M137 HOWITZER TUBE

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Technical Report

5. AUTHOR(S) (First name, middle initial, last name)
A. Imam
T. J. Alix

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U.S. Army Weapons Command

13. ABSTRACT

To study the distribution of the heat affected zone in the bore surface of gun tubes, a 105mm M137 howitzer fired tube was examined. Twelve sections along the length of the tube were obtained, each section being examined at four positions. The distribution of heat affected zone from origin of rifling to about 30 inches beyond seems to support the temperature profile calculations of Nordheim et al[1], who calculated a bore surface temperature of 1000°C at the origin of rifling and 800°C at about 25 inches beyond. A heat affected zone was observed near the muzzle. This phenomenon appeared to result from friction between the projectile and the bore surface.

The literature pertinent to a study of heat affected zone development is reviewed. An attempt is made to interpret the data in terms of the chemical and thermal history of the bore surface.

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7. AUTHOR(s) J.D. Vasilakis		8. CONTRACT OR GRANT NUMBER(s) AMCMS No. 552C.11.22300.02 DA Project No. 1W562603A004 Pron No. M1-2-50022-M1-M7
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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Gun Barrels
Seals
Metal Seals

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report will concern itself with a survey of metal seal literature and will attempt to point out various parameters of interest in the design and testing of metal seals for weapon systems. This will include: (1) experimental metal seal programs; (2) contact problems; and (3) surface topography.

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HYDROSTATIC PRESSURE INDUCED DUCTILITY TRANSITIONS IN PURE BISMUTH AND TIN-BISMUTH ALLOYS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Technical Report

5. AUTHOR(S) (First name, middle initial, last name)

P. T. Dembowski
J. Pepe
T. E. Davidson

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U. S. Army Weapons Command

13. ABSTRACT

The mechanical behavior of pure (99.999%) bismuth and tin-bismuth alloys of [illegible] compositions has been observed over a range of superimposed hydrostatic pressures. Results indicate that maxima in ductility (as measured by percent reduction in area at the fracture surface) in specimens tested at atmospheric pressure occur at compositions bordering pure tin and the eutectic composition. At sufficiently high pressures all compositions failed by rupture, i.e. necking to virtually 100% RA. For pure bismuth, pressure was observed to retard failure due to the formation of cracks at twin-grain boundary intersections; this result was consistent with the hypothesis that the effect of pressure is to shift the mode of crack propagation by decreasing the normal tensile component of stress acting on a crack.

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4. TITLE (and Subtitle) A METHOD FOR PREDICTING WEAR IN CANNON TUBES FIRING AMMUNITION WITH TITANIUM DIOXIDE WEAR REDUCING ADDITIVE		5. TYPE OF REPORT & PERIOD COVERED 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) William F. Rosenberger		8. CONTRACT OR GRANT NUMBER(s) AMCMS No. 662603.11.22300.01 DA Project No. 1W562603A004
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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Gun Barrels
Wear
Wear Rate
Propellants
Propellant Additive
Titanium Dioxide

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A regression analysis is performed to correlate the wear reducing effect of titanium dioxide propellant additive with other weapon characteristics. The amount of reduction in wear is found to be related to projectile muzzle velocity, and an equation is developed which predicts the effect of TiO_2 on wear in a cannon tube.

An existing method for estimating the average wear rate over the life of a weapon is revised to include the effect of TiO_2 additive. Wear rates computed with the revised method are compared with observed wear for several artillery systems.

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3. REPORT TITLE
RELIABILITY DATA ANALYSIS MODEL

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Technical Report

5. AUTHOR(S) (First name, middle initial, last name)
R. Racicot

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U. S. Army Weapons Command

13. ABSTRACT

A computer model has been prepared to assist in the analysis of reliability test data. Essentially, the model computes point estimates and confidence limits for mission reliability of components, subsystems, and systems from component failure data. The main features of the model are: 1. Performs goodness-of-fit tests to determine the best fit probability distribution of component failure times, 2. Computes maximum likelihood estimates of distribution parameters, 3. Computes point estimates of reliability for the renewal nonconstant failure rate case, and 4. Computes lower confidence limits for component, subsystem, and system reliability for the constant failure rate case.

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7. AUTHOR(s) C. Perko D. Costantino		8. CONTRACT OR GRANT NUMBER(s) AMCMS No. 5548.12.283.00.01 DA Project No. 1X654604D258 Pron No. 63-2-92001-(01)-63-M7
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The tendency of the Automatic Gun, 20mm, M138, to fail to extract the first round of an attempted burst was eliminated by the addition of an automatic ammunition lubricator. However, problems of space limitation arose which were subsequently solved by eliminating the lubricator and using M139 barrels with fluted chambers instead.

Tests of three such barrels demonstrated that the use of fluted chambers completely eliminated the failure-to-extract-a-fired-case malfunctions.

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3. REPORT TITLE
EFFECTIVE STIFFNESS FLEXURAL VIBRATIONS OF SIMPLY SUPPORTED RETANGULAR PLATES WITH VELOCITY CORRECTION

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Technical Report

5. AUTHOR(S) (First name, middle initial, last name)
Charles R. Thomas

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U. S. Army Weapons Command

13. ABSTRACT
The previously developed velocity corrected effective stiffness or micro-structure plate theory is utilized to study the flexural vibrations of simply supported rectangular plates and comparisons are made to an effective modulus plate theory. In each case frequency equations for simply supported edges are developed by passing solutions harmonic in both length and width through the differential equations while automatically satisfying the conditions for simple supports. Careful consideration is given to the variations of dimensionless frequency with such dimensionless parameters as width-to-thickness ratio, number of layer pairs, density ratio, thickness ratio, width-to-length ratio, and elastic ratio and such results are discussed graphically.

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6. PERFORMING ORG. REPORT NUMBER:

7. AUTHOR(s): C. Perko
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)
Automatic Weapons
Fabrication
Materials
Gun Barrels
Autofrettaged Gun Barrels
High Temperature Steel
Wall Thickness Ratios

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
A study of the feasibility of designing high pressure (70 to 100 ksi) barrels for rapid fire weapons was initiated. Pressure-travel curves for 30mm barrels at 100 ksi and muzzle velocities in the range of 2800 to 4400 fps were plotted. Wall ratios and thicknesses for barrels operating at bulk temperatures of 500°F, 700°F, and 900°F and 100ksi were computed.

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3. REPORT TITLE
A RELATIVE OPTIMIZATION OF CANTILEVER EULER BEAMS WITH EXAMPLE FOR HAUGER'S PROBLEM

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
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5. AUTHOR(S) (First name, middle initial, last name)
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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U. S. Army Armament Command

13. ABSTRACT

A relative optimization of a generalized non-dimensional form of the cantilevered Euler beam is accomplished by the application of an adjoint variational principle in conjunction with a generalized Ritz procedure. Considerable weight reductions are shown to be possible within the bounds of imposed constraints for a two term Ritz approximation of Hauger's problem.

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ADJOINT VARIATIONAL PRINCIPLES FOR COUPLED THERMOMECHANICAL SYSTEMS AND APPLICATION TO DYNAMIC STABILITY PROBLEMS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

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5. AUTHOR(S) (First name, middle initial, last name)

Julian J. Wu

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10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U. S. Army Armament Command

13. ABSTRACT

In conjunction with the differential equations of coupled thermoelasticity with initial stresses, adjoint variational principles have been formulated in this report by introducing a set of adjoint differential equations. The natural and imposed boundary conditions for the original and the adjoint problems are obtained also with respect to each variational principle. These results can be used as basis for the finite element or other Ritz type of approximations to solve dynamic stability problems with nonconservative loads.

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3 REPORT TITLE

EXTENSIONAL VIBRATIONS OF SIMPLY SUPPORTED LAMINATED RECTANGULAR PLATES

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)

Technical Report

5 AUTHOR(S) (First name, middle initial, last name)

Charles R. Thomas

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10 DISTRIBUTION STATEMENT

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11 SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U. S. Army Armament Command

13 ABSTRACT

The extensional vibrations of simply supported rectangular plates are considered from the viewpoint of the recently derived "effective stiffness" velocity corrected Sun plate theory by passing solutions harmonic in both plate width and length through the differential equations of motion and boundary conditions such that the boundary conditions for simple supports are automatically satisfied. The results are compared to extensional frequencies for a reduced "effective modulus" velocity corrected Sun plate theory. It is concluded that for extensional vibrations a higher order approximation in going to the plate theory is necessary to bring out the effects of microstructure which are present in the continuum theory.

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3. REPORT TITLE
STRAIN ENERGY RELEASE RATE FOR A CRACK UNDER COMBINED MODE I AND MODE II

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Technical Report

5. AUTHOR(S) (First name, middle initial, last name)
M. A. Hussain J. E. Underwood
S. L. Pu

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10. DISTRIBUTION STATEMENT
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11. SUPPLEMENTARY NOTES

12. SPONSORING MILITARY ACTIVITY
U.S. Army Armament Command

13. ABSTRACT

In this paper we have computed the energy release rate for a crack subjected simultaneously to mode I and mode II conditions. The energy was computed by the independent integrals, using the elastic solution of a deflected crack, having a main branch and a propagation branch. The elasticity solution was obtained from the functional integral equations by the process of iterations. This process leads to a point-wise exact solution in the limit as the propagation branch goes to zero. Interestingly enough, the results indicate that the solution in the limit as the propagation branch goes to zero is not the same as the solution with no branch.

Using the Griffith-Irwin criterion, incipient paths of propagation of such a crack were obtained from the maximum value of the energy release rate. To check the validity of the results, an experiment, which gives a pure mode II condition at the tip of the crack, was devised. The results were in excellent agreement with the theory. The energy release rate, in parametric form, can be used for any crack subjected to mode I and mode II loading conditions. To the authors' knowledge such an expression for the energy release rate does not exist in the literature.

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Muzzle Velocity
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A study is made of the errors produced when computing muzzle velocity using the Kravitz method of simplified interior ballistics. A regression analysis of existing weapons is also performed to develop an empirically based velocity prediction equation.

The errors in estimating muzzle velocity associated with the regression equation are found to be smaller than when using the Kravitz method. The regression equation appears to offer several additional advantages over the Kravitz method.

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4 DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

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5 AUTHOR(S) *(First name, middle initial, last name)*

M. A. Hussain
S. L. Pu

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11 SUPPLEMENTARY NOTES	12 SPONSORING MILITARY ACTIVITY
Reprinted from Int. J. Engng Sci, 1973 Vol. 11, pp. 767-781	U.S. Army Armament Command

13 ABSTRACT

In many boundary value problems involving triple integral equations or triple series relations, it is required to solve a single singular integral equation with constant but unknown limits of integration. In this paper we present a variational method to determine approximately the bounded unknown function, if it exists, together with the unknown limits of integration for a type of such singular integral equations. The method is used to recover the exact solution of an integral equation and is applied to a contact problem in the theory of elasticity which is intractable otherwise.

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A COMPARISON OF FLOW AND DEFORMATION THEORIES IN A RADIALLY STRESSED ANNULAR PLATE

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
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5. AUTHOR(S) (First name, middle initial, last name)
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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from Journal of Applied Mechanics March 1973, pp. 283-287	U.S. Army Armament Command

13. ABSTRACT

Two mathematically consistent solutions to the strains and displacement of a partly plastic, annular plate stressed by internal pressure are obtained according to the deformation theory of Hencky and to the flow theory of Prandtl-Reuss. In both cases, the material is assumed to be elastic, perfectly plastic and obeying the Mises yield condition. It is shown that one solution is expressed in closed form and the other, in terms of simple integrals. A quantitative comparison of two theories is given and the effect of compressibility is discussed.

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FORBIDDEN Si (442) STRUCTURE FACTOR

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

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5. AUTHOR(S) (First name, middle initial, last name)

A. Marcus Gray

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U.S. Army Armament Command

13. ABSTRACT

A recent measurement by Trucano and Batterman of the forbidden Si (442) x-ray structure factor prompted us to calculate this value by using a simple model, previously developed by us, for the electronic charge distribution with parameters determined from a given set of allowed formfactors. For the allowed formfactors experimental values of Raccah et al were used. For T = 0°K we found $|F(442)| = 0.082 \pm 0.010$, compared to Trucano and Batterman's bond value of 0.089 ± 0.007 converted to T = 0°K.

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7. AUTHOR(s) H. Powis		8. CONTRACT OR GRANT NUMBER(s) AMCMS No. 0700.01 Pron No. M1-132002-01-M7-M7
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 SARWV-RDT		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
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17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Gun Barrels
Failure
Ammunition Damage

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

On 21 June 1972 at 1415 hours a malfunction of 105mm M1A1 tube, SN 60664, Gun SN 62203 occurred at Fort Bragg, N.C. involving "I" Battery, 3rd Battalion, 10th Marines, 2nd Marine Division, FMF, Camp Lejeune, N.C. This report summarizes the investigation performed on the tube and concludes that failure was caused by an in-bore detonation of the projectile.

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4. TITLE *(and Subtitle)* 175MM GUN M113A1, TUBE SN7101, MALFUNCTION INVESTIGATION		5. TYPE OF REPORT & PERIOD COVERED 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) H. Powis		8. CONTRACT OR GRANT NUMBER(s) AMCMS No. 4440.15.2226.2.02 Pron No. M7-9-P4095-06-M7-M7
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18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Gun Barrels
Failure
Ammunition Damage

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

On 6 February 1972, 175mm Gun M113A1, Tube SN 7101, Breech SN 4970, was involved in a malfunction on the fourth round of a fifty-two round mission in Viet Nam. This report summarizes the investigation and concludes that the failure was due to a premature in-bore explosion of the projectile.

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7. AUTHOR(s): H. Powis
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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Gun Barrels
Failure
Ammunition Damage

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report covers the malfunction investigations of three gun tubes: M1A1 Tube SN 12537, M1A1 Tube SN 11965, and M126E1 Tube SN 20919. The three malfunctions occurred in Viet Nam during May and June of 1970. The report summarizes these investigations and concludes that the tube failures were caused by premature detonation of the projectiles.

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3. REPORT TITLE
STABLE GEODESICS ON SURFACES OF REVOLUTION

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
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5. AUTHOR(S) (First name, middle initial, last name)
Royce W. Soanes

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11. SUPPLEMENTARY NOTES

12. SPONSORING MILITARY ACTIVITY
U.S. Army Armament Command

13. ABSTRACT

A computational scheme is derived for describing stable geodesic curves on surfaces of revolution, where "stable" refers to the particular geodesics along which a flexible filament may be wrapped without lifting from the surface or slipping.

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3. REPORT TITLE

FRACTURE TOUGHNESS AND CRACK GROWTH MEASUREMENTS WITH "C" SHAPED SPECIMENS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Technical Report

5. AUTHOR(S) (First name, middle initial, last name)

D. P. Kendall
J. H. Underwood
D. C. Winters

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10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U.S. Army Armament Command

13. ABSTRACT

A series of "C" shaped fracture toughness specimens from 4330 steel forged cylinders have been tested using the general test procedure recommended by ASTM-E399. A wide range of specimen sizes were tested and no significant size effect on the fracture toughness, as measured by this specimen, was found.

Crack growth during fracture toughness tests was measured using an ultrasonic technique. Based on these results and on a compliance analysis, the use of a 5 percent secant offset fracture criterion is recommended for this specimen.

Standardized specimen dimensions for utilization of the "C" shaped specimen for testing a variety of thick-walled cylinders are recommended.

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FAILURE PHENOMENA OF SOME FIBER-REINFORCED COMPOSITE STRIPS WITH A HOLE

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Y. F. Cheng

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
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13. ABSTRACT

Ten composite strips with a hole (D/W=3/4) were loaded to failure under tension. Failure stresses and strains were compared with the composite ultimate strengths. The results showed that while the hole reduced the composite strength, the effect on strain however depends on the properties of composite components. The strain was reduced in boron-aluminum, but increased in boron-epoxy and in fiberglas-epoxy.

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STRESS CONCENTRATION FACTORS OF SOME FIBER-REINFORCED COMPOSITE STRIPS CONTAINING A HOLE UNDER TENSION OR BENDING

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10. DISTRIBUTION STATEMENT

Approved for public release; distribution unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U.S. Army Armament Command

13. ABSTRACT

Factors of stress concentration were determined, experimentally and analytically, for boron-aluminum, boron-epoxy and fiberglas-epoxy composite material strips containing a hole under tension or bending. In total, ten combinations of constituent modulus ratio, lamina orientation and fiber volume fraction, and three values of hole diameter to strip width ratio were investigated. Experimental values were obtained by means of electric resistance foil strain gages, and analytical results from the NASTRAN finite element analysis. It appears that stress concentration could be minimized by employing angle ply instead of uniaxial or cross-ply, by reducing constituent modulus ratio, and by adjusting fiber volume fraction. Further work is necessary in order to optimize these parameters.

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3. REPORT TITLE

NEW TECHNIQUES IN MEASURING PLASTIC STRAIN IN A MEMORY MATERIAL

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Technical Report

5. AUTHOR(S) (First name, middle initial, last name)

R. V. Milligan

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from Instrument Society of America, ASI 73239 (187-192),1973	U.S. Army Armament Command

13. ABSTRACT

A Nickel-Titanium memory material was studied for the purpose of characterizing its stress-strain behavior, energy absorption capacity, and cyclic response. Instrumentation problems encountered in the testing of this unique material are discussed from the standpoint of thermal recovery effects on strain readings from strain gages and LVDT-type extensometers. Nickel foil type temperature sensors were used to measure surface temperatures from heat generated in the course of plastically straining the material. In addition, the sensors also monitored the heat applied to the specimen to effect thermal recovery from the plastic strain. Temperature-time curves using a strip chart recorder exhibited possible phase changes occurring in the material during thermal recovery after the half cycle of straining.

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Watervliet Arsenal
Watervliet, N.Y. 12189

2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
ORGANIC MATRIX TOUGHENING ADDITIVES FOR COMPOSITE MATERIALS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Technical Report

5. AUTHOR(S) *(First name, middle initial, last name)*
Martin S. Ferguson

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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10. DISTRIBUTION STATEMENT
Approved for public release; distribution unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U.S. Army Armament Command

13. ABSTRACT

Toughening of organic matrix material has been shown feasible using precipitated rubber particles as the discontinuous phase in epoxy resins. Physical tests consisted of recording the work required (as a measure of toughness) to separate a cantilevered cleavage specimen of epoxy matrix with and without these particles. Data is also presented from ASTM tensile tests to assess the extent of sacrifice in elastic modulus and ultimate tensile strength caused by the additions.

Results are presented for three related epoxy resin systems and three hardeners while holding rubber additions at 0 or 10 pph resin. Several resins used in filament winding or casting of composites show beneficial increases in toughness.

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2a. REPORT SECURITY CLASSIFICATION
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3 REPORT TITLE
RELATIVE OPTIMIZATION OF HAUGER'S PROBLEM WITH CIRCULAR CROSS-SECTION

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)
Technical Report

5. AUTHOR(S) (First name, middle initial, last name)
Charles R. Thomas

6 REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO OF REFS
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10 DISTRIBUTION STATEMENT
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11 SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U.S. Army Armament Command

13 ABSTRACT

A relative optimization of Hauger's problem with a circular cross-section is accomplished by the application of an adjoint variational principle in conjunction with a generalized Ritz procedure. Considerable weight reductions are shown to be possible within the bounds of imposed constraints for a two term Ritz approximation of Hauger's problem. The circular cross-section optimization is shown to yield a relatively lower mass than a corresponding procedure for a rectangular cross-section.

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1. ORIGINATING ACTIVITY *(Corporate author)*

Watervliet Arsenal
Watervliet, N.Y. 12189

2a. REPORT SECURITY CLASSIFICATION

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2b. GROUP

3. REPORT TITLE

FLEXURE EQUATIONS OF MOTION FOR LAMINATED COMPOSITE BEAMS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Technical Report

5. AUTHOR(S) *(First name, middle initial, last name)*

Charles R. Thomas

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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10. DISTRIBUTION STATEMENT

Approved for public release; distribution unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U.S. Army Armament Command

13. ABSTRACT

With little actual effort and no recourse to new derivations, a flexural theory for laminated composite beams is obtained directly from a reduction of existing flexure equations for composite plates. Results previously developed for plate strips are shown to be directly applicable to beam problems if slight changes are made in the elastic constants.

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3. REPORT TITLE

DYNAMICS OF ROTATING DEFORMABLE SOLIDS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Technical Report

5. AUTHOR(S) (First name, middle initial, last name)

C. L. Anderson

6. REPORT DATE November 1973	7a. TOTAL NO. OF PAGES 98	7b. NO. OF REFS 46
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10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY U.S. Army Armament Command

13. ABSTRACT

The kinematics of rotating deformable solids are developed, and a conservation law is postulated. The general equations of motion for a deformable solid rotating about a fixed axis are obtained from this conservation law, which then serves as the theoretical basis for the derivation of suitable beam theories for rotating beams and shafts subjected to conservative and non-conservative loads. The effects of internal and external damping as well as gyroscopic inertial forces are included in the formulation.

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Automatic Drafting Machine
Cam path
Drafting
FORTRAN

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This is a report on a practical and simple application of an automatic drafting machine. Cam paths normally drawn by hand are now computerized and drawn in less than two hours. A FORTRAN program has been written to cover all types of cam paths drawings.

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Watervliet, N.Y. 12189

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE

STRESS SINGULARITIES ASSOCIATED WITH A CRACK INCLINED TO A BI-MATERIAL INTERFACE

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Technical Report

5. AUTHOR(S) *(First name, middle initial, last name)*
S. L. Pu
R. D. Scanlon
M. A. Hussain

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from Developments in Mechanics, Vol. 7, pp 349-364, Proceedings of the 13th Midwestern Mechanics Conference: 26.	U.S. Army Armament Command

13. ABSTRACT

In this paper we have investigated the nature of stress singularities associated with a crack inclined to a bimaterial interface, under general loading conditions. The stress singularities were obtained from the eigenvalues of a characteristic equation. Careful study of these results indicated a physical paradox. We could find no angle of inclination of the crack tip to the interface for which the singularity had the same order as that of a crack tip lying in either of the individual materials.

The problem was then reformulated incorporating boundary layer effects via couple stress theory. The most dramatic result found was that there are only two possible angles of inclination of a crack to the interface for which the singular stress field of a crack in a homogeneous material could be preserved. This suggests that there are only two possible paths of propagation of a crack as it approaches an interface.

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Watervliet Arsenal
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2b. GROUP

3 REPORT TITLE

HOW MICROSTRUCTURE INFLUENCES MECHANICAL PROPERTIES OF FORGINGS

4 DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Technical Report

5 AUTHOR(S) *(First name, middle initial, last name)*

C. J. Nolan
T. V. Brassard
R. S. DeFries

6 REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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11 SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from Metals Engineering Quarterly, May 1973	U.S. Army Armament Command

13 ABSTRACT

A series of laboratory isothermal heat treatments was employed to develop and characterize the low-temperature transformation products or microstructures in large cylindrical forgings for pressure vessels. Tensile properties, hardness, and impact energy transition curves were determined for the various microstructures produced. Of the three microstructures investigated, tempered martensite provided the optimum combination of strength and toughness. The tempered bainite structure developed during isothermal transformation, produced both low yield and impact strengths.

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3. REPORT TITLE

A NON-LINEAR FORMULATION OF THE EQUATIONS OF MOTION OF A ROTATING BAR

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Technical Report

5. AUTHOR(S) (First name, middle initial, last name)

Gary L. Anderson

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10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U.S. Army Armament Command

13. ABSTRACT

The non-linear equations of motion of a slender beam rotating at constant angular velocity about a transverse axis are formulated. The state of stress in the bar is assumed to consist of two parts: (i) the initial state of stress associated with the undisturbed "equilibrium" configuration of the rotating bar and (ii) the state of stress associated with the disturbed motion about the configuration of undisturbed "equilibrium." The equations for the equilibrium state and the disturbed motion are separated and linearized, neglecting non-linear terms as well as gradients of initial displacements. As examples of the theory developed, the equations of motion for the longitudinal and flexural deformations of a rotating bar carrying a tip mass are derived. The longitudinal displacement and stress are shown to become unbounded at certain rotational velocities.

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1. ORIGINATING ACTIVITY *(Corporate author)*

Watervliet Arsenal
Watervliet, N.Y. 12189

2a. REPORT SECURITY CLASSIFICATION

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2b. GROUP

3. REPORT TITLE

BAYESIAN INFERENCES ON FUNCTIONS OF THE PARAMETERS OF UNIVARIATE DISTRIBUTIONS USING ESTIMATOR DISTRIBUTION

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Technical Report

5. AUTHOR(S) *(First name, middle initial, last name)*

Ronald L. Racicot

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U.S. Army Armament Command

13. ABSTRACT

In the Bayesian approach to determining inferencing information, the likelihood function is often used as the conditional distribution of sample outcome given the population parameters. For the more difficult problems involving quantities which are functions of more than one population parameter, use of the likelihood function can lead to very tedious computations. Computational efficiency can be improved in many instances if the distribution of estimators is used rather than the likelihood function. The use of the estimator distribution in determining Bayesian intervals is discussed with application being made to the Weibull mean. Exactness from a classical frequency viewpoint of the Bayesian intervals assuming uniform priors was also studied.

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3. REPORT TITLE

PHOTOELASTIC STRESS ANALYSIS OF TWO SLIDE BLOCK BREECH DESIGNS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Technical Report

5. AUTHOR(S) (First name, middle initial, last name)

G. Peter O'Hara

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10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U.S. Army Armament Command

13. ABSTRACT

The work presented is an extension of the Watervliet Arsenal Report "Photoelastic Stress Analysis of Conventional and Serrated Slide Block Breech Designs", WVT-6830 by T. F. MacLaughlin. The current work is an analysis of two more possible designs for slide block breeches. The "Open Jaw" design is a possible lightweight configuration and the "90° U" would be useful in some cases where space is limited. The variation of fillet stress along the fillet is reported for all the block cavity fillets along with stresses at other points of interest. The lateral deflection of the sides of the breech ring is also reported.

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2b. GROUP

3. REPORT TITLE

TEMPERATURE MEASUREMENT AND WARNING SYSTEMS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Technical Report

5. AUTHOR(S) *(First name, middle initial, last name)*

Herbert Frankel

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U.S. Army Armament Command

13. ABSTRACT

A thermistor varies the frequency of a tiny oscillator mounted on a gun tube. The temperature signal is received 6 inches away. This avoids the breakage of thermocouple wires because of recoil.

A thermistor causes a circuit to oscillate when a gun tube reaches 350°F. One wire, fastened to the gun mount instead of the tube, allows a small receiver to warn personnel when the critical temperature is reached.

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